Strategic Transport Apprenticeship Taskforce

Skills Forecasting

Baseline Study

HS2 Crossrail Department for Transport Heathrow Making every journey better highways england The Institute of Couriers Rail Delivery Group National Rail

PSS NetworkRail think logistics The National Skills Academy RAIL TRANSPORT FOR LONDON SKANSKA TUC maritime

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Foreword

I am pleased to present this skills forecasting baseline study which sets out data demonstrating the need for more talent in our industry; as well as the need to enhance the skills of our workforce to meet the changing technological landscape.

We know that the sector faces skills shortages and gaps, and that despite some improvements our current workforce does not in most areas represent our diverse nation or the communities we serve. We will use the findings to help drive the change that we want to see. We now have a comprehensive picture of the type of skills we need and when we need them, for both rail and road.

Since STAT begun in 2016 (and as NSAR has continued its work), more employers in the industry are now taking action to address the skills gaps, and smaller employers are also considering how and where apprenticeships can form part of their business plans. Apprenticeships are the key to meeting future skills requirements, and the transport sector is showing real leadership in this area. Apprenticeship "starts" within transport are increasing, bucking the trend experienced by employers in other sectors and diversity is improving, albeit more slowly than we would like to see.

This initial success is underpinned by well informed, evidence based interventions, made collectively across the industry, to meet the future pipeline of transport infrastructure programmes.

This report can be a call to action for other employers, particularly those in our shared rail and roads supply chains, where the vast majority of the transport workforce sits. By working together, we can create the high quality training opportunities we need to attract and retain future talent. This is important as we consider collectively how we can respond to the need, set out in this report, for increasing skills requirements for new employees as well as further development and training for existing staff.

As STAT develops our future work programme, we will use this model to further increase our understanding of priority areas and disciplines and build our knowledge of workplace characteristics to support our efforts to improve diversity and look at other parts of the transport sector.

We in STAT, and NSAR, will share this data widely across the industry, so that even more employers can position themselves to meet the challenges and opportunities increased skills demand presents. I look forward to working closely with these colleagues as we shape and develop this work together, to be a true exemplar of high quality training opportunities for all.

Mike Brown,
Commissioner, Transport for London and Chair of STAT and NSAR.

Executive Summary

Investment in infrastructure is fundamental for productivity and growth, particularly as the UK prepares to leave the EU. Investment in transport infrastructure is trebling – to a historic high – but without clear intervention there will not be enough talented people to lead the development and delivery of the projects required.

The Strategic Transport Apprenticeship Taskforce (STAT) is part of this clear intervention. STAT was established to deliver the Transport Infrastructure Skills Strategy[1] (TISS), and as a part of this plan we commissioned, through the National Skills Academy for Rail (NSAR), the development of the most detailed skills forecasting tool the transport industry has ever had. This tool can demonstrate the extent to which, as a sector, we need to be gearing up to meet the workforce requirements of the future.

This baseline study sets out current workforce and future needs for the rail and road sector against known investment plans or, where these are yet to be set, against our best case assumptions.

It makes sense to look across rail and roads. Whilst both modes have their specialisms, we are essentially looking at a shared supply chain. This is especially true when it comes to infrastructure construction. In addition, wider infrastructure construction and government's ambitions around housing will also have an impact, although these are not considered within the scope of this study.

So what have we found? Unsurprisingly, across rail and roads we will need more people in the future. This is partly a function of increased investment, and partly a function of sections of our workforce approaching retirement age. Brexit adds additional uncertainty. However we do not yet know how this will impact that workforce and our model therefore does not include assumptions around Brexit.

In both rail and roads the maintenance and operations workforce remains relatively stable, but the project workforce, dependent on levels of capital investment, is where we see the most significant increases in labour requirement.

In rail we are due to lose 50,000 people by 2033 due to retirement. This will be felt more acutely at operative level in our investment workforce. In roads we will need an additional 25,000 people by 2025, driven by increased investment; and an additional 16,000 people if we are to replace those who are due to retire. This includes 25% more people than we have currently working on investment projects.

So we are looking at shortages in our traditional trades. In turn this risks inefficiency and poor productivity.

As the nature of the work in our sector changes, we have potential skills gaps. Our need for people with higher skillsets

1 Transport Infrastructure Skills Strategy: building sustainable skills

will increase, particularly for those around skill levels 3 and 4, primarily driven by developments in technology, increasing digitalisation and also by different ways of doing things, for example the move towards offsite construction and smart asset management. This means both existing roles will change and may require increased levels of competence; and new roles will emerge which require skillsets not previously needed in conventional transport roles.

On diversity we have made progress, but this has been modest and there is more to do to make sure we are able to access the full range of talent the sector needs. The gender balance of the rail sector has been steadily improving, albeit against a poor historic baseline. In the four years to 2017, the percentage of women in the rail workforce increased from 8% to 12%, with the proportion of women in rail engineering doubling to 8%. In the roads sector, the percentage of females has remained relatively stable at around 20% over the same time period.

This baseline study sets out the extent of the challenge. A challenge we will need to overcome through investment in skills if we are going to play our part in improving productivity and driving growth through infrastructure investment in line with our national strategic objectives.

As our One Year On report shows, STAT is already driving improvements, removing barriers, exploiting latent demand, and encouraging collaboration to increase the quantity and quality of skills in the workforce.

Partners are already taking action, contracts are being revised, apprenticeship starts are increasing and diversity is improving. We are making progress and there is more to do. This report, and more importantly the underlying data, is useful guidance for our collective journey.

Introduction to:

Strategic Transport Apprenticeship Taskforce (STAT)

The taskforce is the voluntary, cross industry body that has been given the responsibility for meeting stretching targets for apprenticeships, improved sector diversity and promoting transport as a career.

STAT was established in April 2016 to deliver on the ambition of the Transport Infrastructure Skills Strategy. The work has shown that transport is on the front foot in responding to skills shortages, and we can clearly see opportunities right across the sector. It is imperative to redouble efforts as we develop our plans for productivity and growth in a post Brexit Britain.

Membership of STAT has grown and now includes representatives from the Rail Delivery Group, the Trades Union Congress, Heathrow Airport, maritime, ports and road freight sectors. Board membership includes apprentices, bringing their first-hand experience into our work.

National Skills Academy for Rail (NSAR)

The National Skills Academy for Rail (NSAR) is a membership organisation established to enable the sector to deliver a modern and efficient, world class railway through the development of a highly skilled and productive workforce. Established in November 2010, NSAR consists of over 360 members and acts as an authority within the industry maintaining strong relationships with key stakeholder groups in the sector. In June 2013, NSAR was presented with a BS11000 Certificate of Registration for Collaborative Business Relationships.

NSAR is the leading voice of the rail industry for people and skills and provides advice on a wide range of issues. NSAR exerts its influence in several ways such as, taking a position in the media, direct discussion with government ministers, participation on governance and strategic industry bodies and committees, discussions with civil servants, responses to consultation documents and through production of research and policy papers.

Background and Introduction

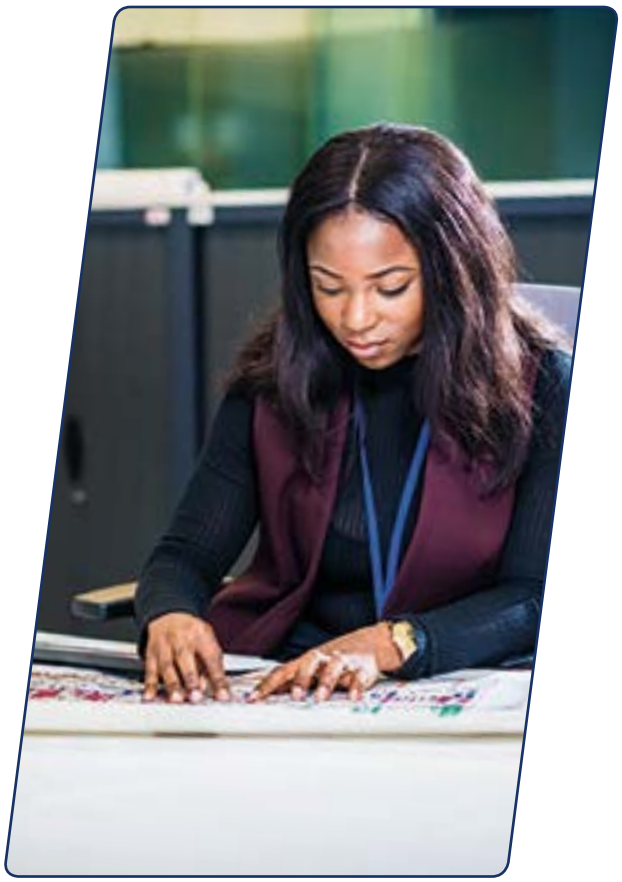
This report has been developed following consultation between the Strategic Transport Apprenticeship Taskforce (STAT) and the National Skills Academy for Rail (NSAR). The remit was to review the existing workforce initially in rail and latterly road, review investment levels and establish the necessary workforce required to deliver that investment.

The report is structured to show analysis of today's available workforce, investment plans (both secured and assumed), and the subsequent required workforce to enable the success of these projects within the rail and roads sectors of the transport industry.

NSAR has developed a Skills Intelligence Model (SIM) which allows the comparison of today's available workforce against the future required workforce, by analysing investment plans and applying a series of algorithms to develop a required future workforce number. This metadata can be 'diced and sliced' in any number of ways using different variables and factors, for both transport sectors, thus generating a series of outputs. This will then determine where best to focus industry efforts in developing and recruiting the next generation of rail and road sector workers.

Workforce characteristics have been collected from a mixture of employer provided databases as well as data provided by the Sentinel system[2], allowing an accumulation of intelligence on nearly 224,000 members of the rail workforce. Our working assumption is that this data is approximately 90% complete. Therefore it is not unreasonable to assume that the rail industry has a workforce closer to 250,000.

At this time it has not been possible to collect a full set of workforce characteristics for today's workforce for the roads sector. Any information that is available has been used and analysed in this report.[3]



2 Sentinel is one of the premier safety systems in use across the Rail Industry, providing rail workers with a passport to work on rail infrastructure across the United Kingdom.

3 Roads workforce characteristics data has been sourced from Highways England Annual Diversity Survey (2017).

Today's Available Workforce

Data has been collected across the rail and road transport sectors to generate a profile of the industry, providing a snapshot of the characteristics of the workforce. From a gender and diversity perspective it has been easier to collect gender data and not at all easy to collect ethnicity data. As a result no ethnic diversity data is presented in this report, however this will be reflected in a further study. STAT is working hard to address this data collection issue with employers across the industry. This study has found modest progress in terms of male/female gender diversity although both aspects are areas which need continued work to meet the challenging ambitions set out in the Transport Infrastructure Skills Strategy (TISS).[4] The data collected also covers the skill levels of the current workforce with analysis around how the workforce is likely to transform given changes implemented through developing and emerging technologies within the industry. The workforce today has a significant proportion of low skilled workers. The modelling forecasts higher skilled individuals will be required to meet the demands of the investment.

Rail

For the purposes of this report, data has been collected on 224,000 rail employees, (estimated to be 90% of the total rail workforce), a reflective sample of the industry's available workforce. Data has been provided either directly from employers or from the Sentinel system.

Figure 1 shows the split of the 224,000 workforce numbers, as defined from the gathered data records. The different Work Types are classified as:

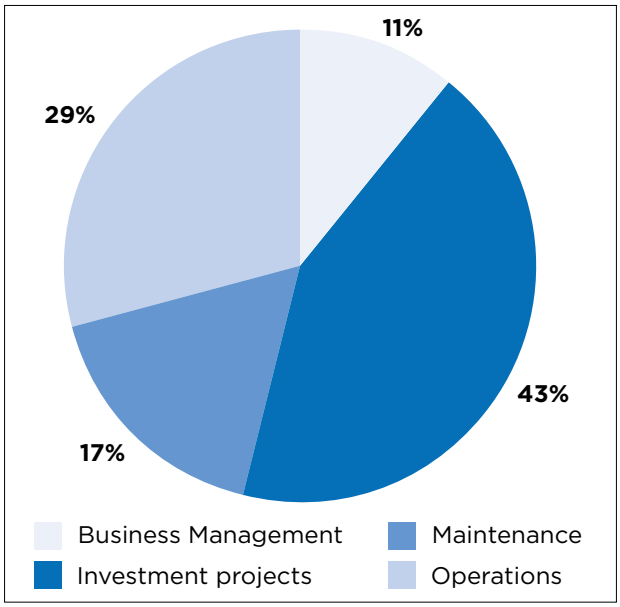
- Business Management e.g. Finance, Administration and Human Resources
- Investment Projects e.g. those employees working on delivery of investment programmes, including construction, engineering construction and design elements
- Maintenance e.g. technicians and engineers who repair and maintain track and overhead electrification wires
- Operations e.g. drivers, signallers and those who are responsible for passenger movements.

The rail workforce also includes those involved in Manufacturing[5] (e.g. of rolling stock), however, there was a low survey response from this sector and therefore we have not included these figures in our data. We estimate that this sector may account for approximately 1% of the workforce. Investment Projects and Operations account for the majority of the workforce.

4 Transport Infrastructure Skills Strategy: building sustainable skills; Moving Britain Ahead (2016)

5 Due to a low return of information from Manufacturing, any results have been excluded from the report.

Figure 1: Rail industry defined by work type (note: excludes Manufacturing)

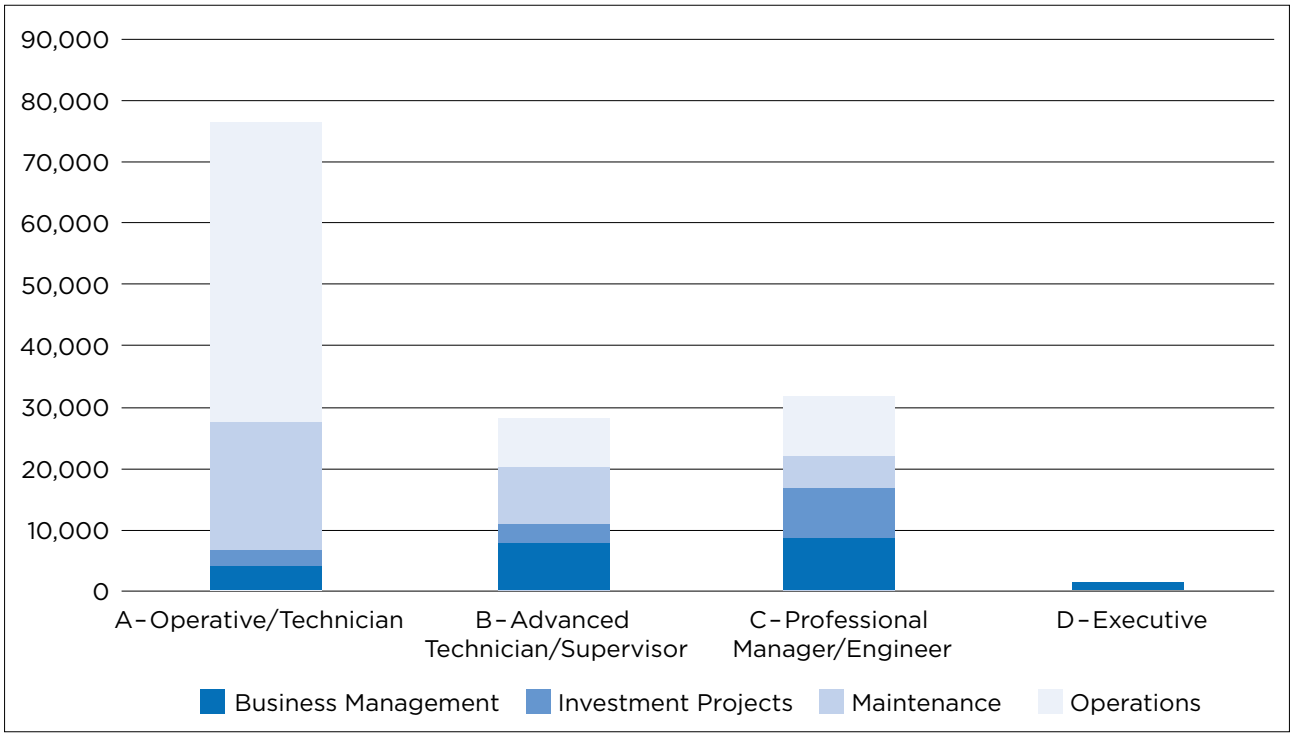


Within the model the source of the investment is recorded by region, enabling a reflection of the workforce demands at a geographical level.

Investment drives workforce demand, so as published in the One Year On report[6], demand will increase in the Midlands and the North West with the construction of HS2. However, increasingly, investment in one region can also drive demand in others. For example, approximately 62% of Crossrail contracts have been awarded to businesses outside of London. It is estimated that Crossrail construction, including the supply chain, is supporting 55,000 full time equivalent roles across the UK.

Characteristics considered for rail include skill level, age and gender. The full list can be found in Appendix 2. Limited characteristics were available for roads and these have been derived from the annual diversity survey carried out by Highways England, covering its supply chain.[7]

Figure 2: Work type by skill level: rail



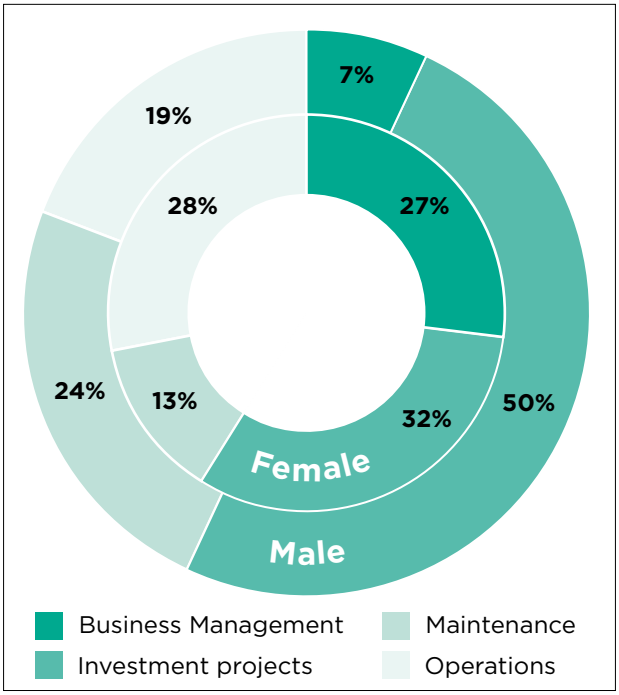
6 Transport Infrastructure Skills Strategy – One Year On Report

7 Highways England Diversity Data Benchmarking Supply Chain Workforce Profile Data 2017.

Workers at skill level A (Operative/ Technician), account for 68% of the workforce in Operations and Maintenance. There are few at skill level D (Executives) across the sectors, with the majority in Business Management, as illustrated in Figure 2. The Sentinel database does not hold job role level data for individuals, which is the key component for determining the skill level of each role. As a result, it has not always been possible to allocate skill levels in the Investment Projects work type.

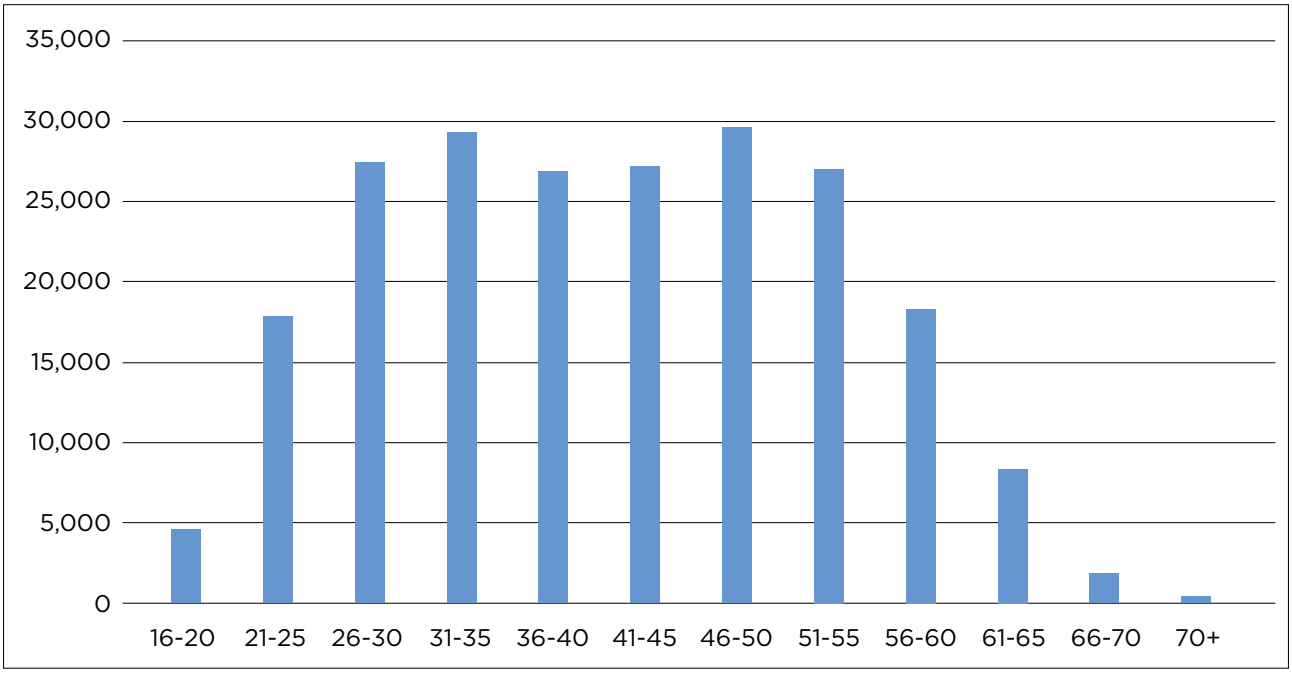
The gender imbalance across the industry remains skewed in the favour of males, particularly in Maintenance as Figure 3 illustrates. 55% of the female workforce are based in Business Management and Operations. Data analysis shows the balance has been steadily improving, albeit against a poor historic baseline. In the four years prior to 2017, the percentage of women in the rail workforce increased from 8% to 12%, and the proportion of women in rail engineering doubled to 8%.[8]

Figure 3: Work type by gender: rail



The age range of the available workforce in Figure 4, shows the youngest employees at 16 years of age through to the oldest at 90 years of age. Both the mean and median ages of the industry workforce are 42. 43% of the available workforce is over the age of 40.

Figure 4: Age of available workforce: rail



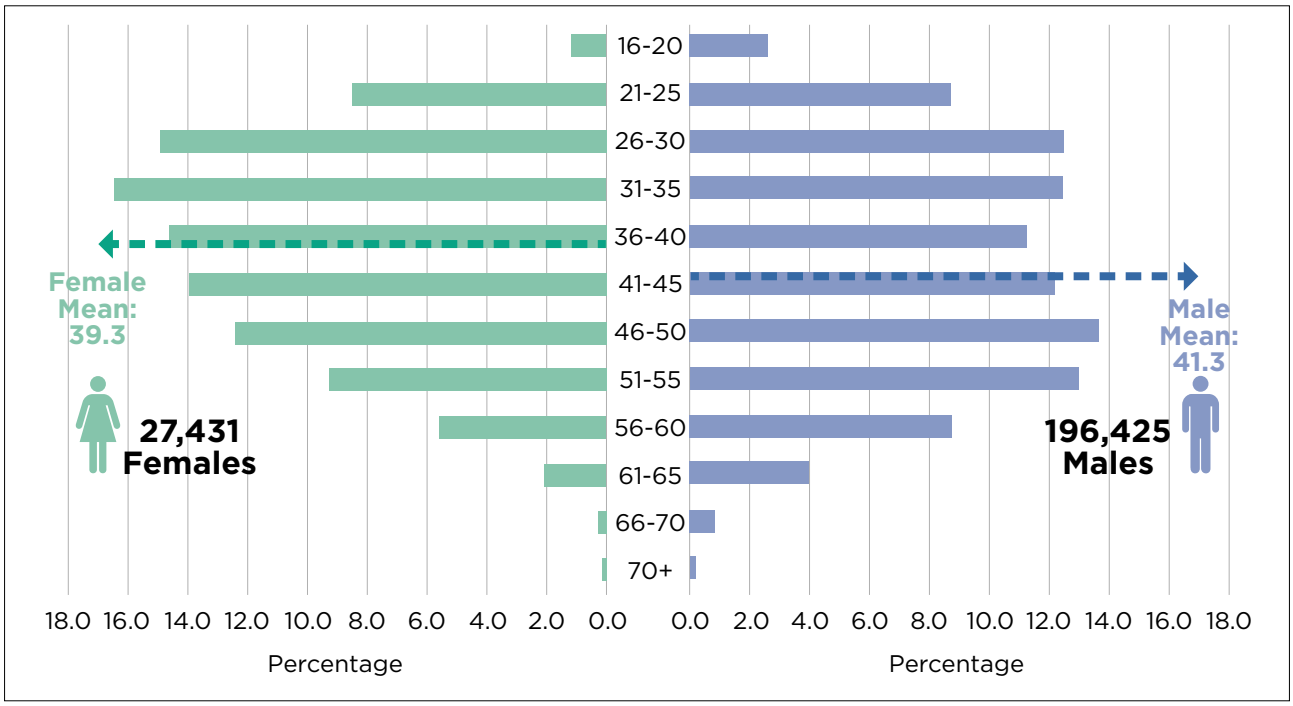
8 National Skills Academy for Rail Engineering (NSARE) Traction & Rolling Stock Resources Review Report (2015).

Over 9,000 employees are over the age of 60, equating to 4% of the available workforce.

10% of the industry is 25 or under, 47% are under 40, 73% under 50 and 27% over 50. Further discussion about the impact of this age profile will take place in the future workforce section. The age profile of the rail sector is reflective of the national workforce, with the median employee age at 42 years.

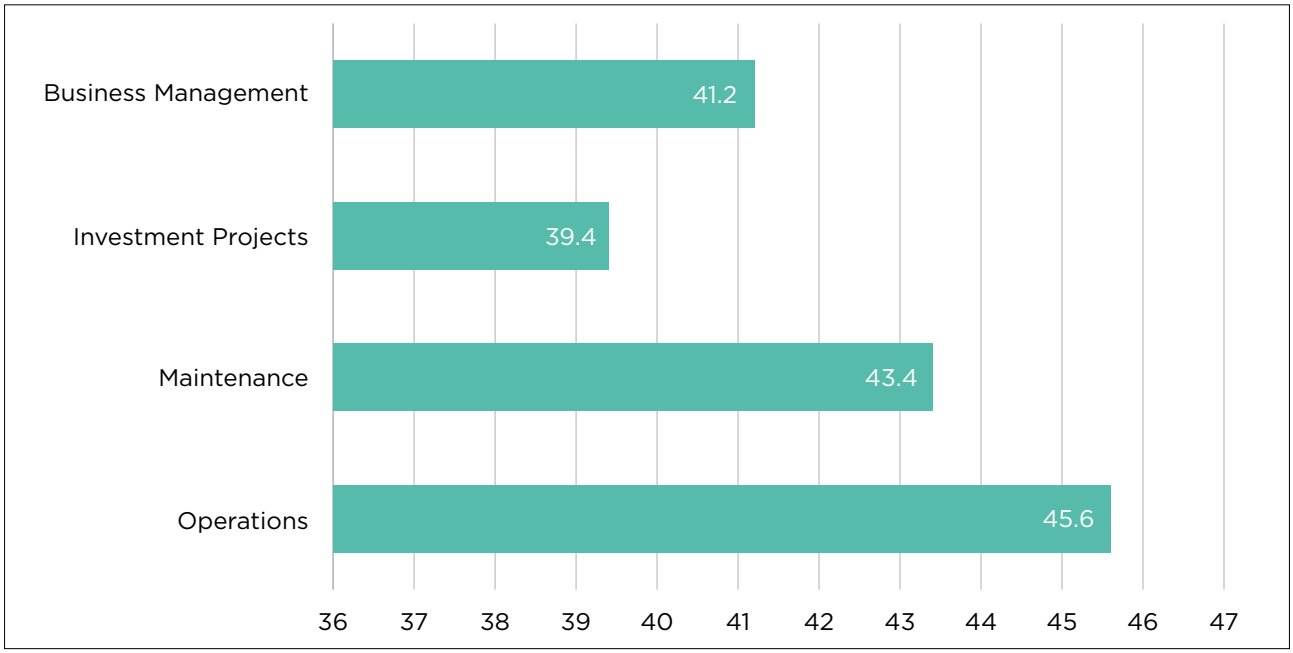
Figure 5 illustrates the age distribution, where there is a clear difference between the spread of ages, leading to notable variance in the mean ages between the genders in rail; the mean age of females is two years younger than that of males. There are higher proportions of the female workforce in the younger age bands, illustrating a younger female workforce. This suggests a career in rail is becoming more accessible and attractive to younger professional women.

Figure 5: Workforce characteristics: rail



The average age ranges shown in Figure 6 display a profile that shows clear contrast by work type discipline. Operations has the highest average age and as this work type encompasses drivers and signallers, there could be implications for these roles as digital systems are introduced and implemented.

Figure 6: Average age of workforce by work type: rail

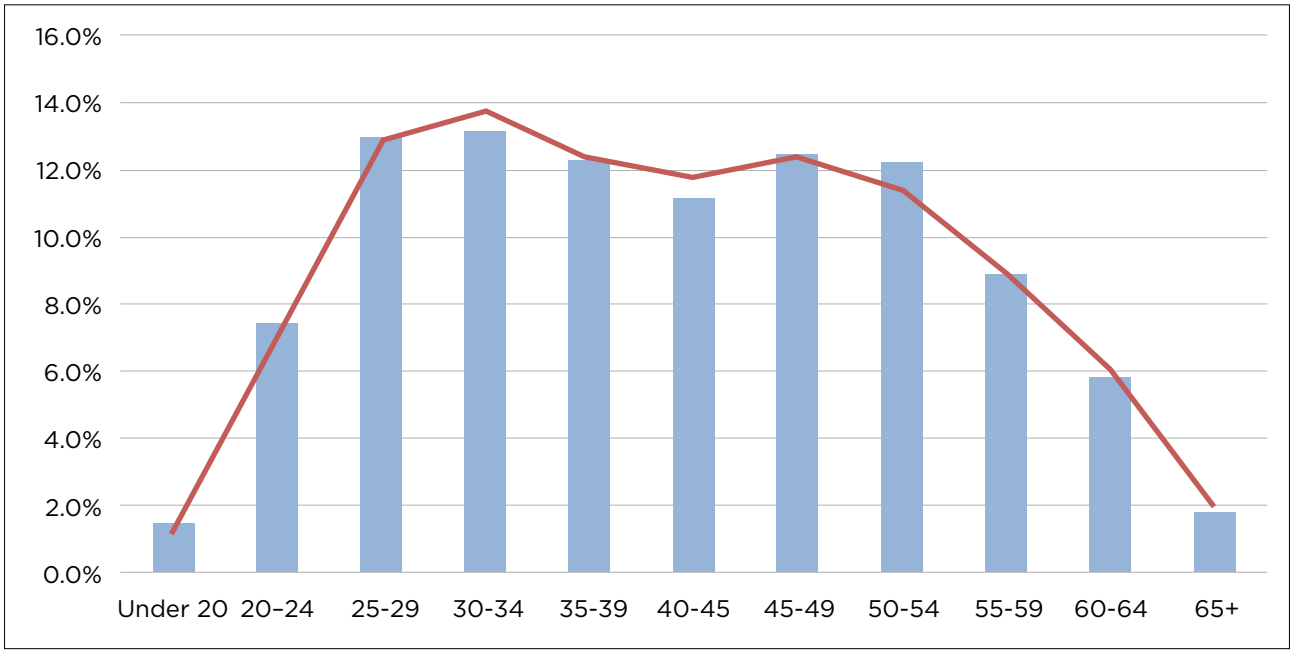


Road

Data has been collected on over 53,000 employees, which represents approximately 75% of the total estimated workforce. The work types here are defined as consultants (e.g. design) or contractors.

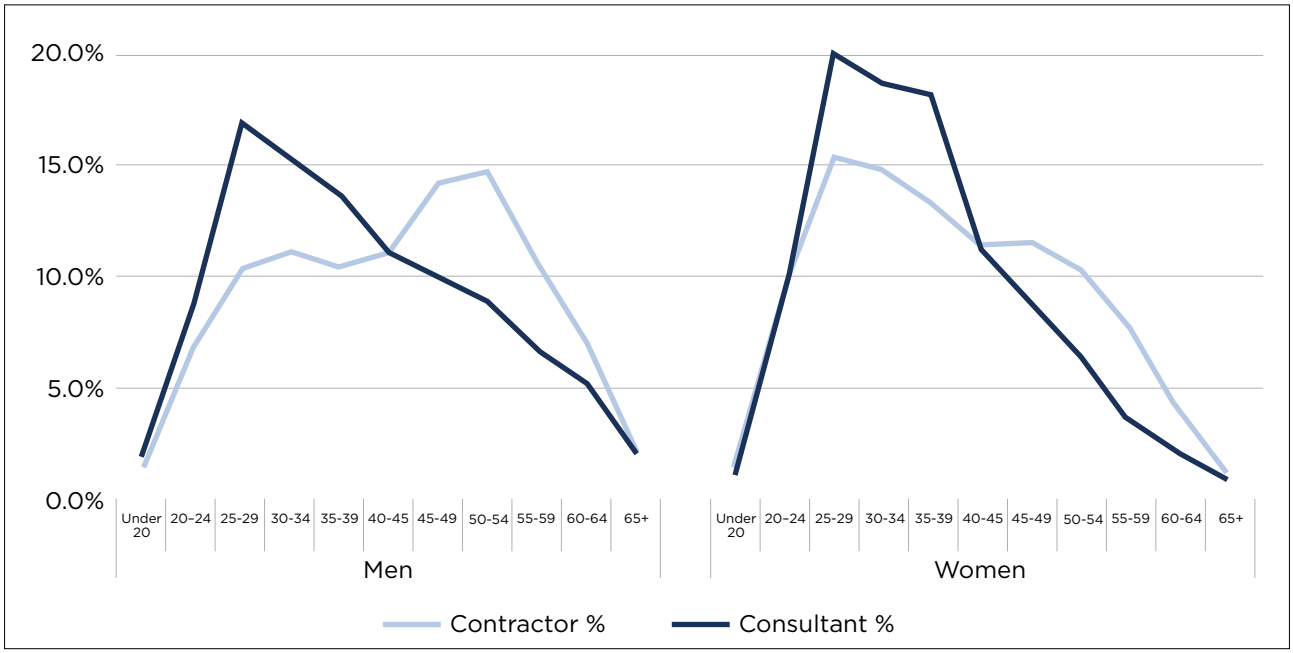
Age and gender characteristics have also been analysed with comparisons drawn where possible. The age bands are slightly different to those used in rail, although data shows peaks in ages between 30–34 and 45–49 as illustrated in Figure 7. Overall, the age profile within the rail and roads sectors are generally reflective of each other displaying a dip in the middle age bands.

Figure 7: Age profile of workforce: road



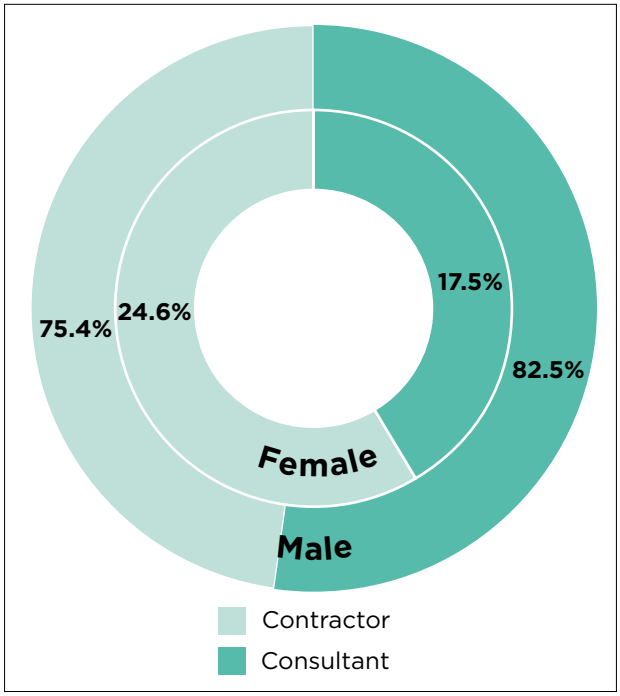
Both males and females have a higher proportion of their respective workforce working as consultants in the lower age bands, illustrating this type of role is more popular than contractual work at this stage in their professional life. Contract work is preferred to consultant work, according to the age distribution graphs shown in Figure 8, notably from the age of 45 onwards. This is possibly representative of workers wanting to ensure a regular source of income. An analysis in the diversity survey looked at part time workers, which showed males were dominant in the 60–65+ age category compared with females where the peak is 35–39. These peaks for part time work can be related to social norms, where females would be traditionally looking after young children while males look to reduce their hours before completely retiring.

Figure 8: Age distribution of consultants and contractors by gender: road



From a gender perspective, the workforce population split is 79% male and 21% female, demonstrating a better representation of females in the workforce compared to rail. Figure 9 illustrates the gender proportions by work type.

Figure 9: Work type by gender: road



Investment Plans

Rail & Road

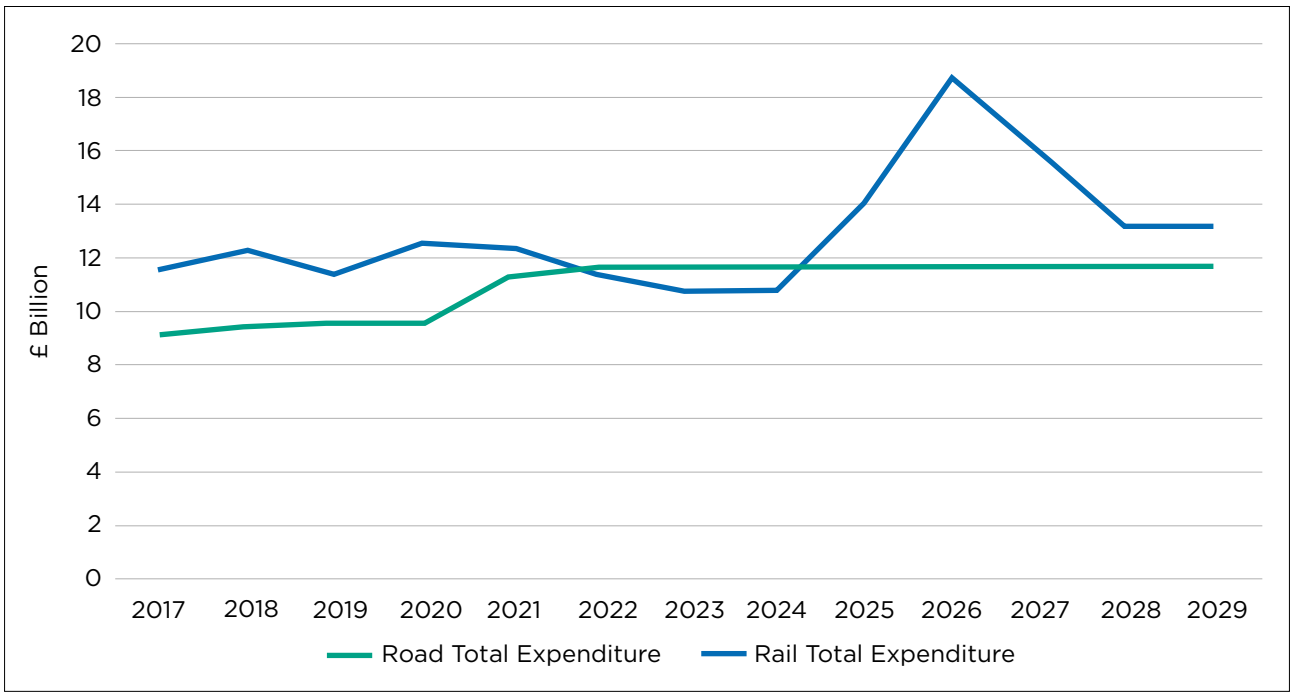
Publicly available investment information has been collated and uploaded into our Skills Intelligence Model (SIM). It has been assumed that where information is not yet available for future investment periods, funding will remain constant. Full details about the investment plans used can be found in Appendices 3 & 4.

From the investment profile, sustained growth across both sectors is evidenced. With this indication, and that of the age profile alongside the potential, but yet unknown impact of Brexit, the industry needs to be ready for the demands of this investment. The Infrastructure and Projects Authority (IPA) estimate there are approximately 160,000 people employed in construction covering both rail and roads sectors. With careful planning, the utilisation of the workforce can be maximised across both transport sectors, to ensure both project budgets and delivery deadlines are met.

Each investment plan element across both transport sectors has been allocated to a particular work type, asset type, year and region. The following years are used as reflective comparators: the current picture, 2021, 2025 and 2029 (rail only); no assumptions beyond 2025 for road have been made in this report.

Figure 10 shows the levels of investment across rail and road between 2017 and 2029, based on assumptions made for the purposes of this report. The model and the assumptions will be updated as necessary when new investment information becomes available.

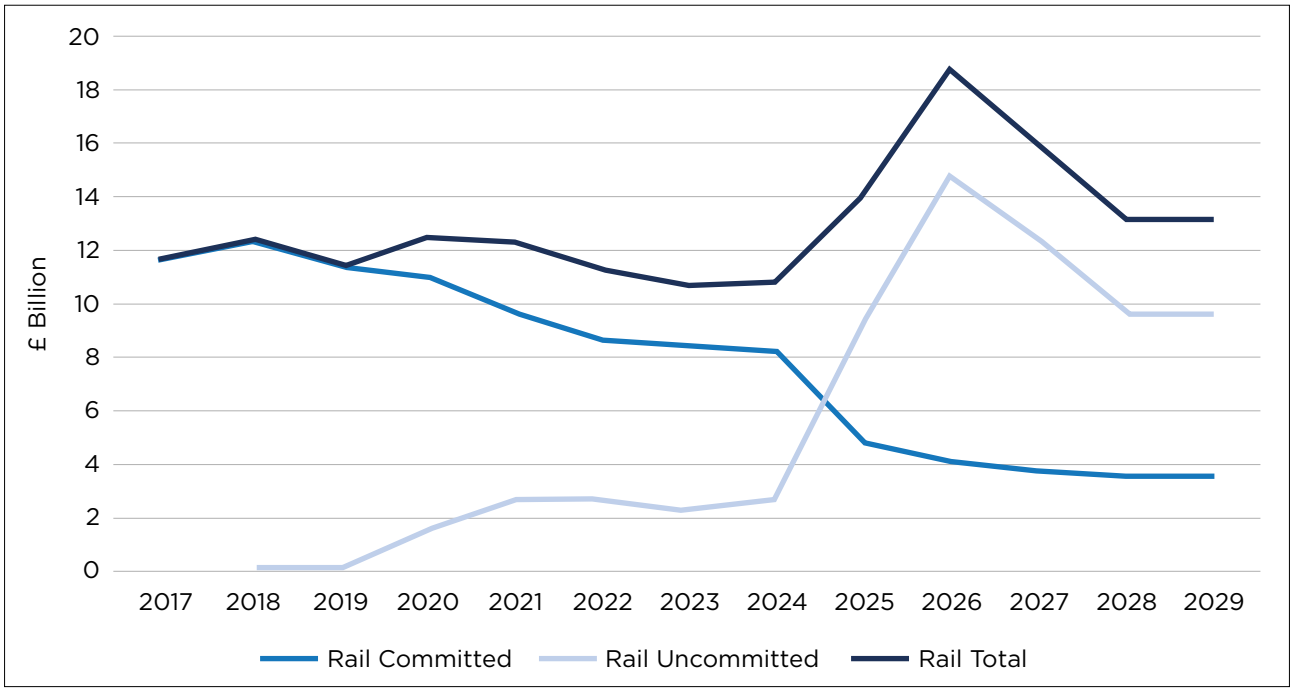
Figure 10: Total transport investment forecast



Rail

The largest work type is Investment Projects. Assuming the forecasts of investment are accurate for Crossrail 2, the industry will see capital expenditure of funding in excess of £10bn per annum, rising significantly between 2024 and 2026 (Figure 11). The end of Crossrail 2 denotes a drop off with our assumptions running to the end of the funding period.

Figure 11: Projected rail expenditure

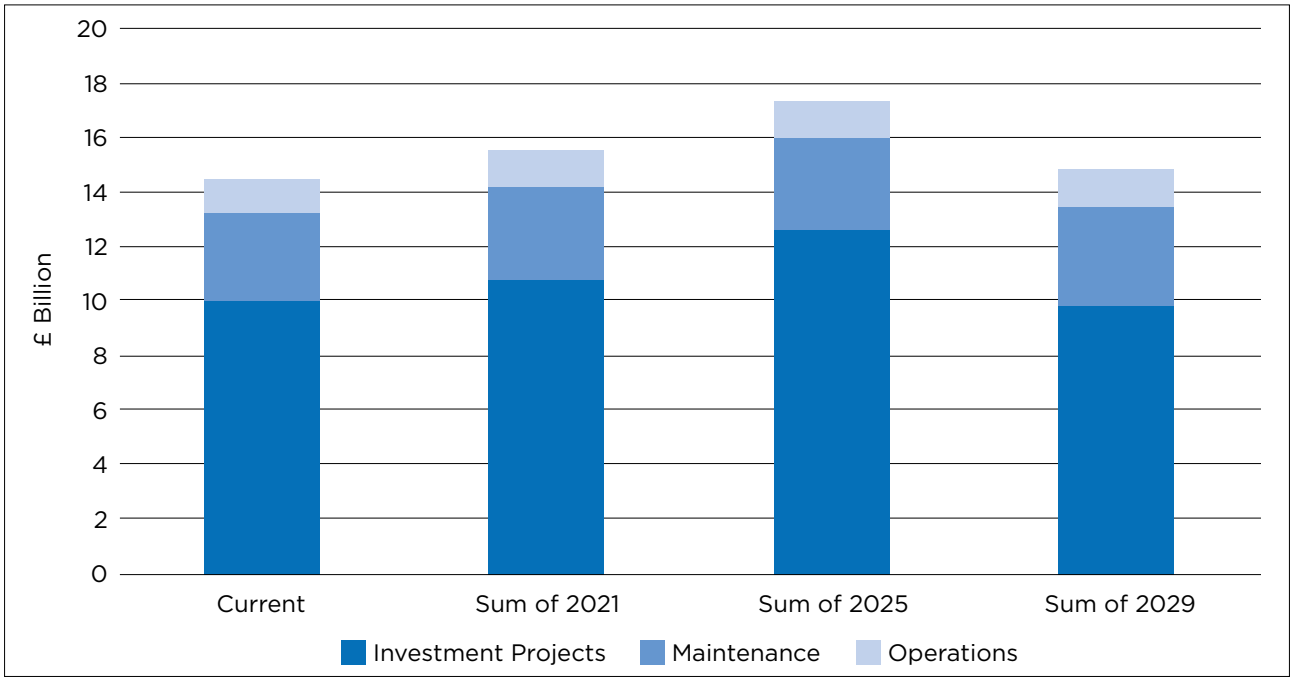


Expenditure by Work Type

The information in Figure 12 shows how the investment levels are split into the four-comparator years using work type analysis. Work types include Business Management (Finance, Human Resources and Administration)[9], Investment Projects (Infrastructure Construction), Maintenance (Renewal and Enhancement of existing Assets) and Operations (day to day running of the rail network, trains and stations). Expenditure in each work type reflects the sustained investment, with a slight decline in 2029 echoing the currently assumed work profile post Crossrail 2.

9 Business Management has not been modelled in investment plans at the time of the report

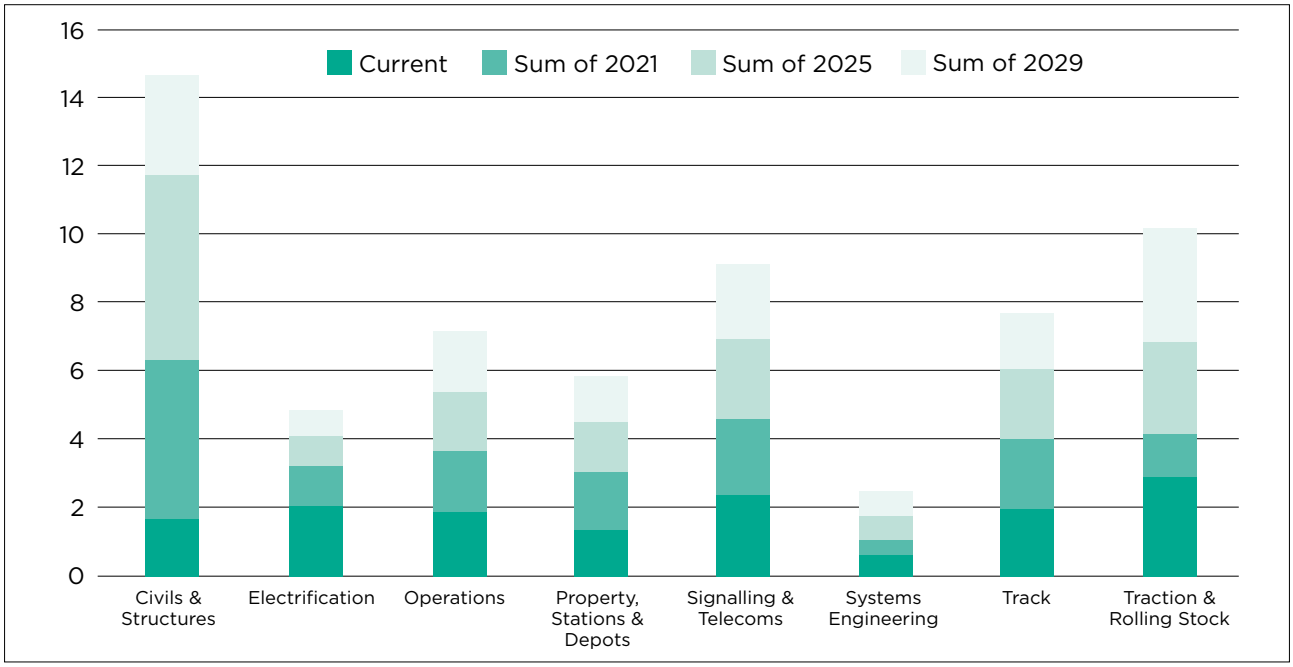
Figure 12: Investment by work type: rail



Expenditure by Asset Type

Figure 13 shows the investment levels split into the four comparator years using asset type. The largest spend is in Civils & Structures emphasising the levels of investment in both underground and overground, in particular HS2 and Crossrail 2. There is a sharp fall in electrification expenditure post 2021. Investment in the Digital Railway is represented as Systems Engineering in the model and subsequent outputs.

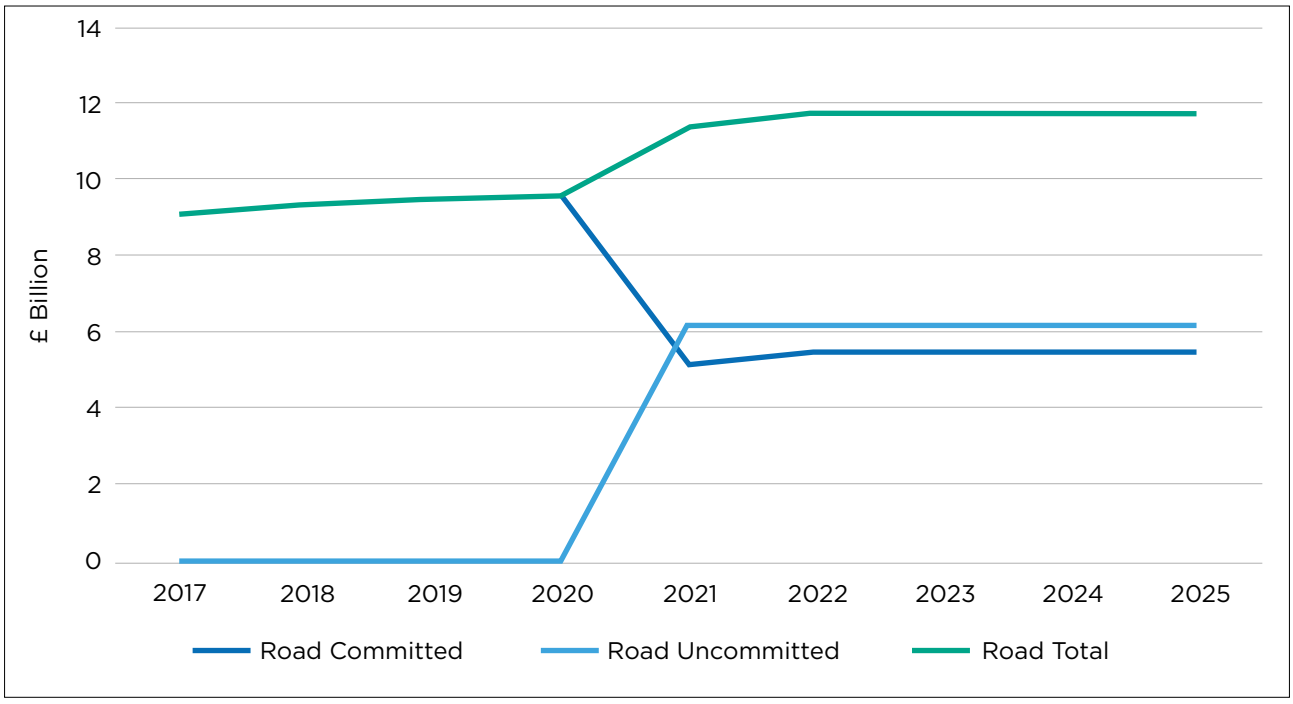
Figure 13: Investment by asset type: rail



Road

Figure 14 illustrates the planned investment expenditure for roads covering a shorter period to rail, up to the end of 2025. The profile shows sustained investment levels across the time frame, with expenditure in excess of £11bn per annum post 2020.

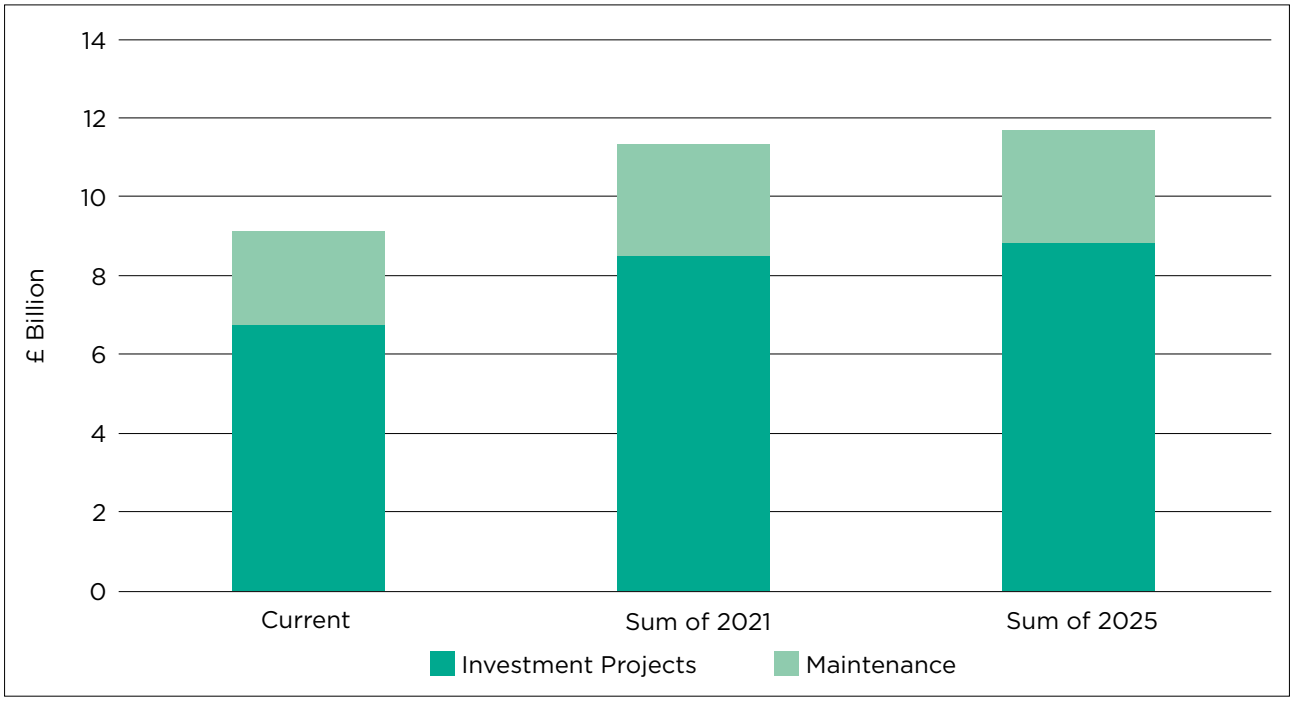
Figure 14: Projected road expenditure to 2025



Expenditure by Work Type

Figure 15 illustrates the split of investment across the three comparator years; current; 2021; and 2025; by work type which includes Investment Projects (Infrastructure Construction) and Maintenance (Renewal and Enhancement of existing assets). The levels of investment illustrate a projected increase in both projects and maintenance through the timeframe reflecting the sustained levels of investment.

Figure 15: Investment expenditure by work type: road

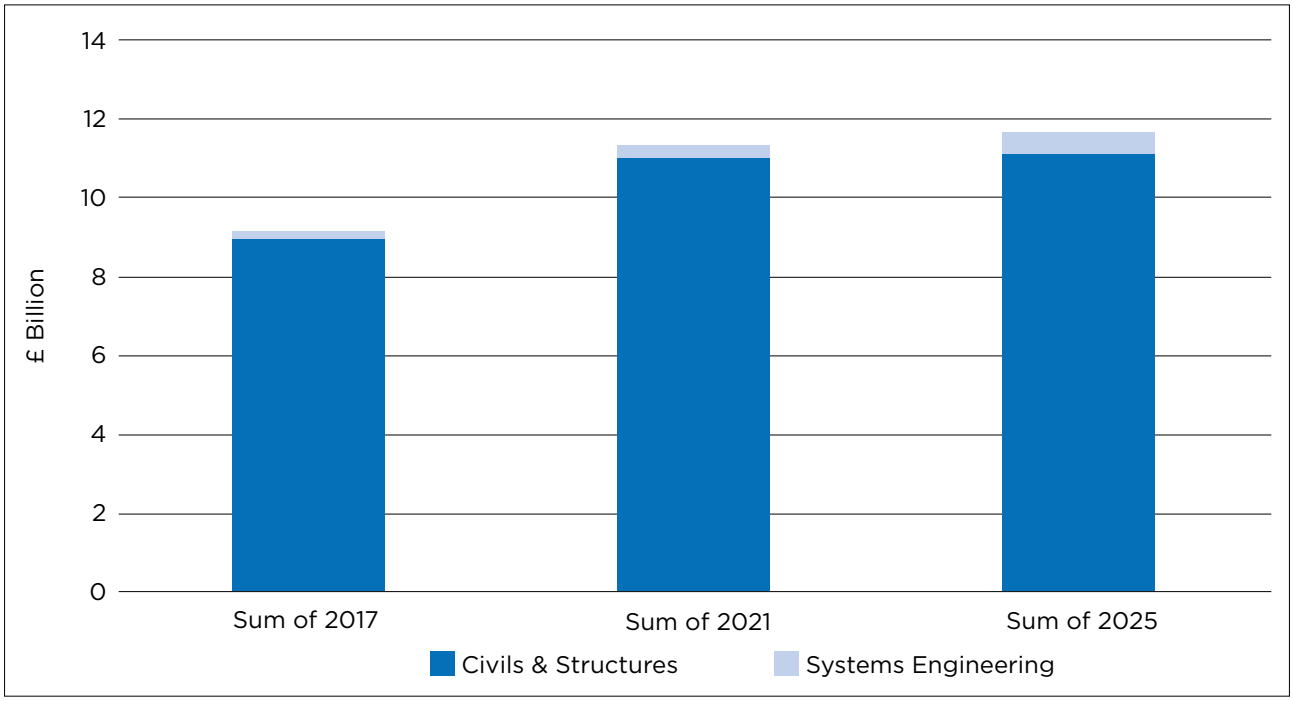


Expenditure by Asset Type

There is a steady and consistent increase in the expenditure for Civils & Structures in the road sector (Figure 16). Systems Engineering (covering the integration of key elements within a system including hardware, software, firmware, people, information techniques, facilities and services to achieve the required system capability and performance through the implementation of a given system, for example, a smart motorway system) shows an upward trend in investment levels. Information beyond 2020 assumes the investment levels will show a slight increase compared to pre 2020. Information from local authority figures[10] relates to maintenance of the current roads network within their regional jurisdictions. Once new investment information is released the model will be updated accordingly.

10 Highways Maintenance Funding Formula Allocations

Figure 16: Investment by asset type: road



Future Workforce

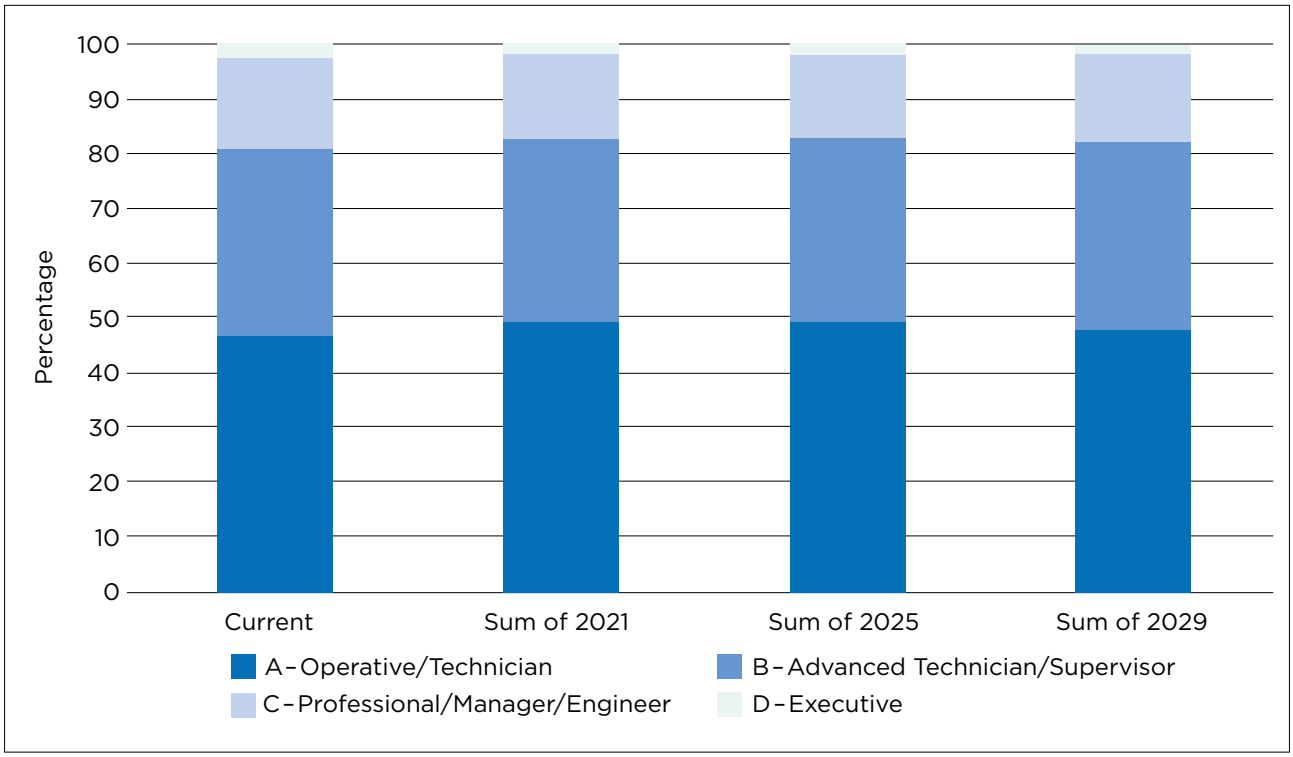
Rail

Figure 17 shows the overall numbers required in total across each year through the selected time frame. There is a peak in the number of people and skills required in 2021, notably in investment projects where an additional 14,000 are required to meet the demand. This is centred on the development of HS2 with other peaks in the workforce particularly dependent upon when the works begin in earnest for Crossrail 2. Increased skill levels are required in Civils & Structures, Property, Stations & Depots and in Signalling & Telecomms. Continued reliability of investment will lead the supply chain to have greater confidence and assurance of the work pipeline leading to investment of up-skilling individuals.

Figure 17: Projected workforce by work type: rail

The requirement for higher skilled workers is particularly evident between the current picture and 2021 (Figure 18). This trend continues through the years, albeit at more moderate levels. The ongoing development of technologies combined with the Digital Railway will continue to drive the demand for higher skill sets leading to more highly qualified workers at each level of the spectrum.

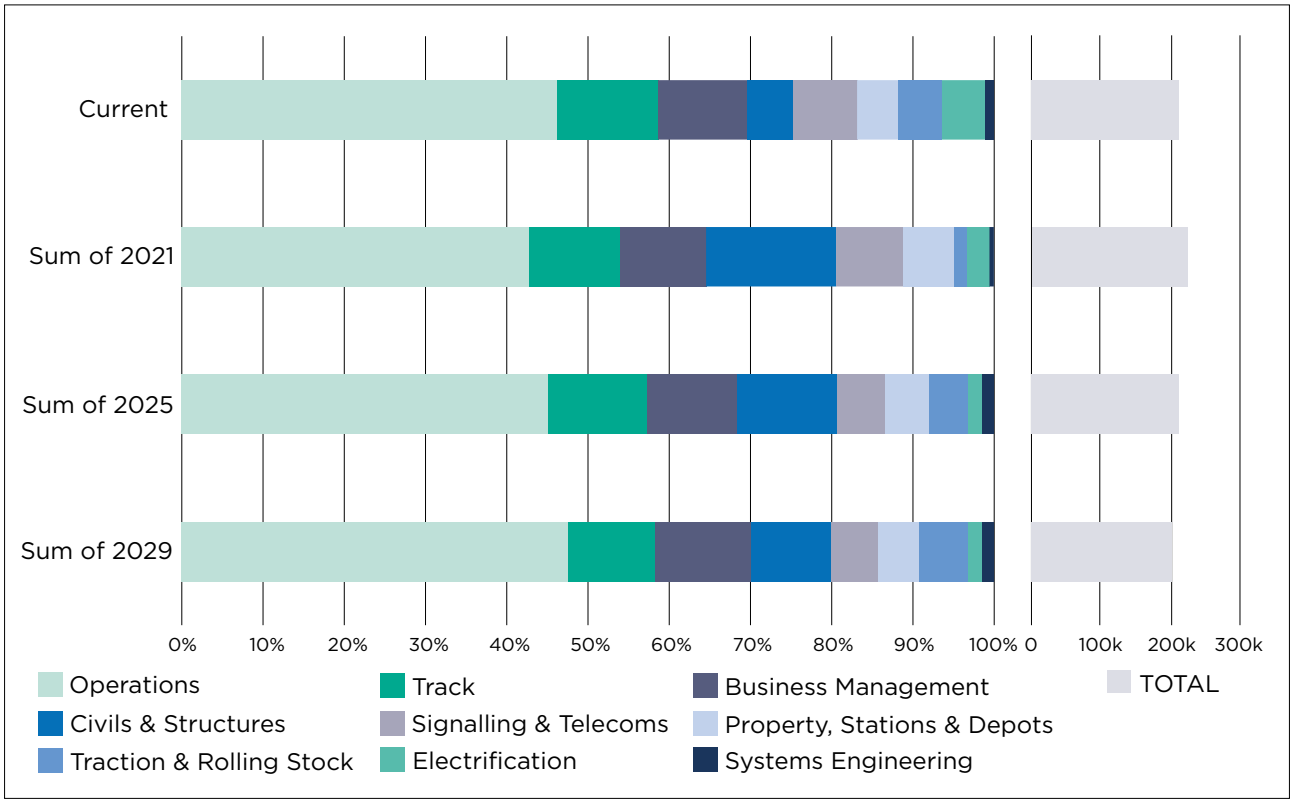
Figure 18: Projected workforce by skill level: rail



With an increasing demand for digitalisation in disciplines such as Systems Engineering in both rail and road, and in Signalling & Telecomms technologies, these areas will require skilled individuals at the appropriate levels.

The data demonstrates an increased need for higher skilled individuals. For example, there is a need for 2,000 extra signallers from the current number up to 2021, whilst Systems Engineering see a 44% increase in appropriately qualified people required by 2020. Telecommunications has a 50% increase in its personnel needs in the same period, further demonstrating the increased need for people with a digital skill set.

Figure 19: Projected workforce by asset type: rail

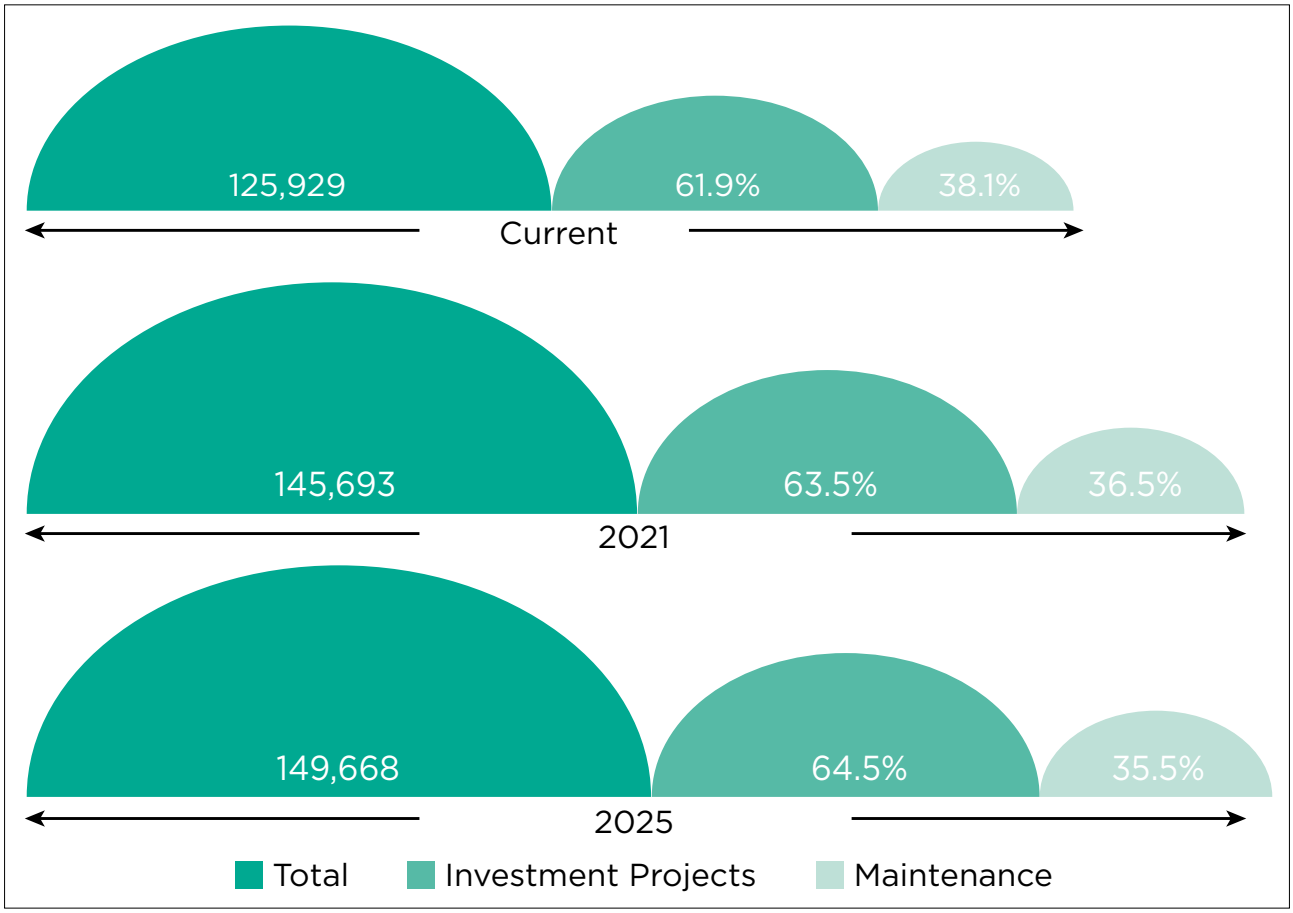


Road

For the purposes of comparison with rail and for consistency, the current picture, 2021, and 2025 have been used as benchmarks for analysis. Figure 20 illustrates an overview of workers required across each year through the timeframe. The numbers indicate an increase in personnel required rising from approximately 125,000 to 150,000 by 2025.

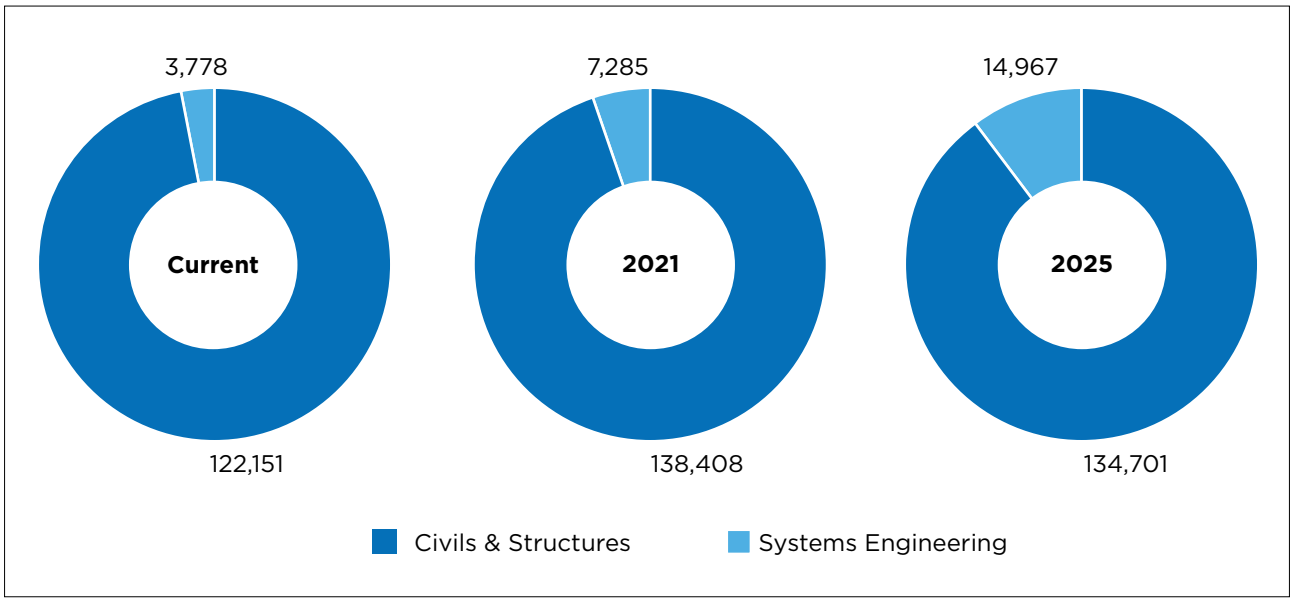
From the two work types evident in the roads sector, the majority of people required are in Investment projects work, which is anticipated to rise 25% from the current numbers by 2025. With continued technological advancements demands for increased skills are inevitable. There will, however, always be the need for maintenance work.

Figure 20: Projected workforce by work type: road



In the roads sector two asset types exist: Civils & Structures and Systems Engineering, (including roles such as systems integrators and controllers). Both the smart motorways programme and greater use of technology will improve the operation, maintenance and enhancement of the road network. Available data is limited, but the belief is growth will be seen in this area. Preliminary work as part of the next funding cycle already sees a number of scoping projects underway in preparation for further implementation of smart motorway technology. By 2025 approximately 90% of Investment is focussed on Civils work.

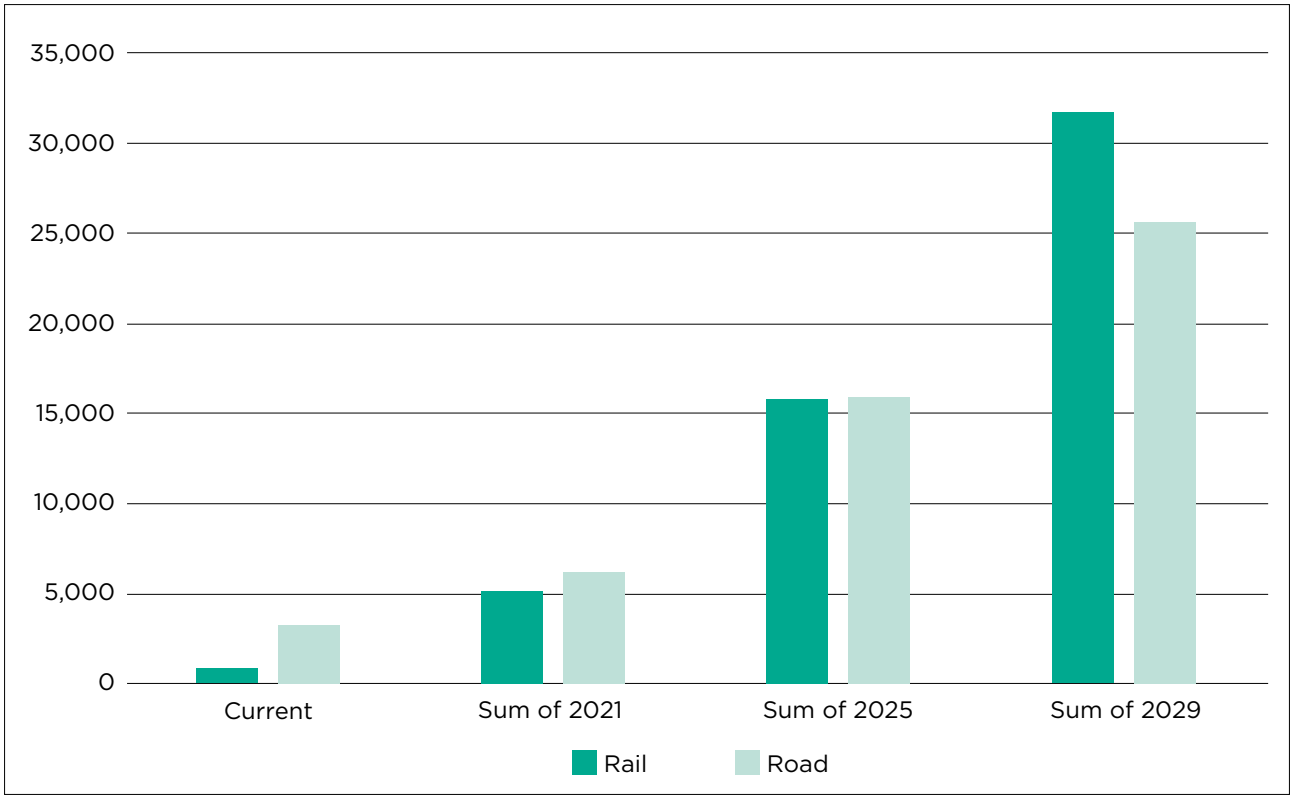
Figure 21: Projected workforce by asset type: road



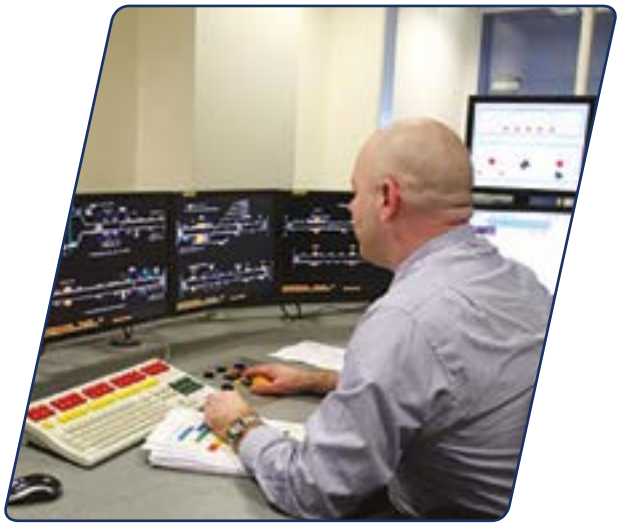
The age profile of the workforce is a factor when planning for the future. On the assumption that the retirement age is 65, Figure 22 shows the number of people in the workforce reaching this age this year, in 2021, 2025 and 2029. As a result, by 2033, the rail industry will have potentially lost approximately 50,000 members of staff due to retirement; of those 50,000, 8% are females. In road, the number of retirees by 2025 is approximately 16,000.

This needs to be considered in view of any, as yet unknown, workforce impacts from Brexit where, anecdotally, 10% of the workforce could potentially leave the UK.

Figure 22: Projected cumulative number of retirees: rail and road



Of those due to reach retirement age by 2029, 47% are at Operative level, 33% at Supervisor level, 20% at Managerial level and 1% at Executive level. Across the work types this equates to 40% in Investment Projects, 30% in Operations and 21% in Maintenance activities. These figures are proportionate to the percentages at each skill level, with the exception of those at Managerial level, where the number of retirees is higher.



Productivity

From the modelling assumptions made in this report, no productivity savings have been factored in.

Productivity remains an issue, not only for rail and road, but across the wider infrastructure and construction sectors in general. In short, there is a productivity gap. Whilst the service and manufacturing sector has delivered significant increases in productivity over the last 10 years, construction has delivered very little improvement.

This has to change. There have been many reviews into the construction industry and productivity which have identified a range of factors that contribute to low productivity. Having the right skills though is a consistent and common theme identified as an enabler to driving productivity forward. Whilst this version of the report is setting a baseline and is therefore focused on today's methods and skills, a fundamental element of success will be developing the skills of tomorrow.

In practice this means two things: Firstly, the skills we know today will still in many cases be needed, however, people will need to have a different level of competence in their chosen area. Whether that be a senior leader who will need to be more able to manage and drive change through an increasingly changing environment, or a foreman who knows how to get the best out of his team, or the labourer who knows how to carry out his task more safely and becomes more used to contributing an idea to a 'lean method' of working.

Secondly, rapid developments in technology, smarter client focus on outcomes, development of improved procurement methods, greater visibility and predictability of demand, and developments in plant, equipment and manufacturing are combining to present the industry with an unrivalled opportunity to make a real step forward in productivity. Examples of the opportunities that lie before us are smart, modular, catalogue design, augmented reality, off site manufacture, deployment of on and off site production techniques, logistical planning, building information modelling, intelligent sensor monitoring of assets, use of big data and data analytics and smart asset management. This is commonly called the fourth industrial revolution. This not only offers opportunities to drive productivity forward but also to improve many of the other dimensions that are important to the infrastructure sectors such as safety, quality, and customer service. The impact will be seen across the design, build, operate, and maintain lifecycle. Predicting future change is notoriously difficult, but the forward direction in many areas is now clear and investment in the skills of tomorrow will be an imperative to business success.

9 ONS Data – Richard Postance.

We therefore see a workforce of the future comprising people who hold the traditional skills but have a shift in capability, and 'new' skills which are more prominent in the workforce of tomorrow.

Both these areas are under threat from skills shortages unless action is taken. The age demographic means traditional skills are going to be lost at a greater rate than they are being replaced. For the growing area of 'new' and emerging skills, shortages could be particularly acute as these are the areas with the lowest existing base of labour – but with the highest proportional increase in demand. Re-skilling will also therefore be an important strategy, and the emergence and prominence of new skills is also likely to support the image and attractiveness of the sector.

Conclusions

Standing back from the detail of the data, there are a number of conclusions we would invite the reader to consider.

This is a baseline review, intended to establish the best current picture for rail and road. It will be used as a solid base to measure progress and change, and to assist with planning. The historic assumption that the market will take care of the provision of skills is no longer safe, as witnessed by underinvestment in training leading to wage inflation and skills shortages. So infrastructure plans should (and increasingly do) take cognisance of the shape of the workforce, from an early stage. This baseline will help inform those plans.

The data, and the associated analysis model will evolve, with assumptions revised as environmental conditions change. These will range from new technology, improved productivity and geopolitical impacts on skills supply e.g. Brexit.

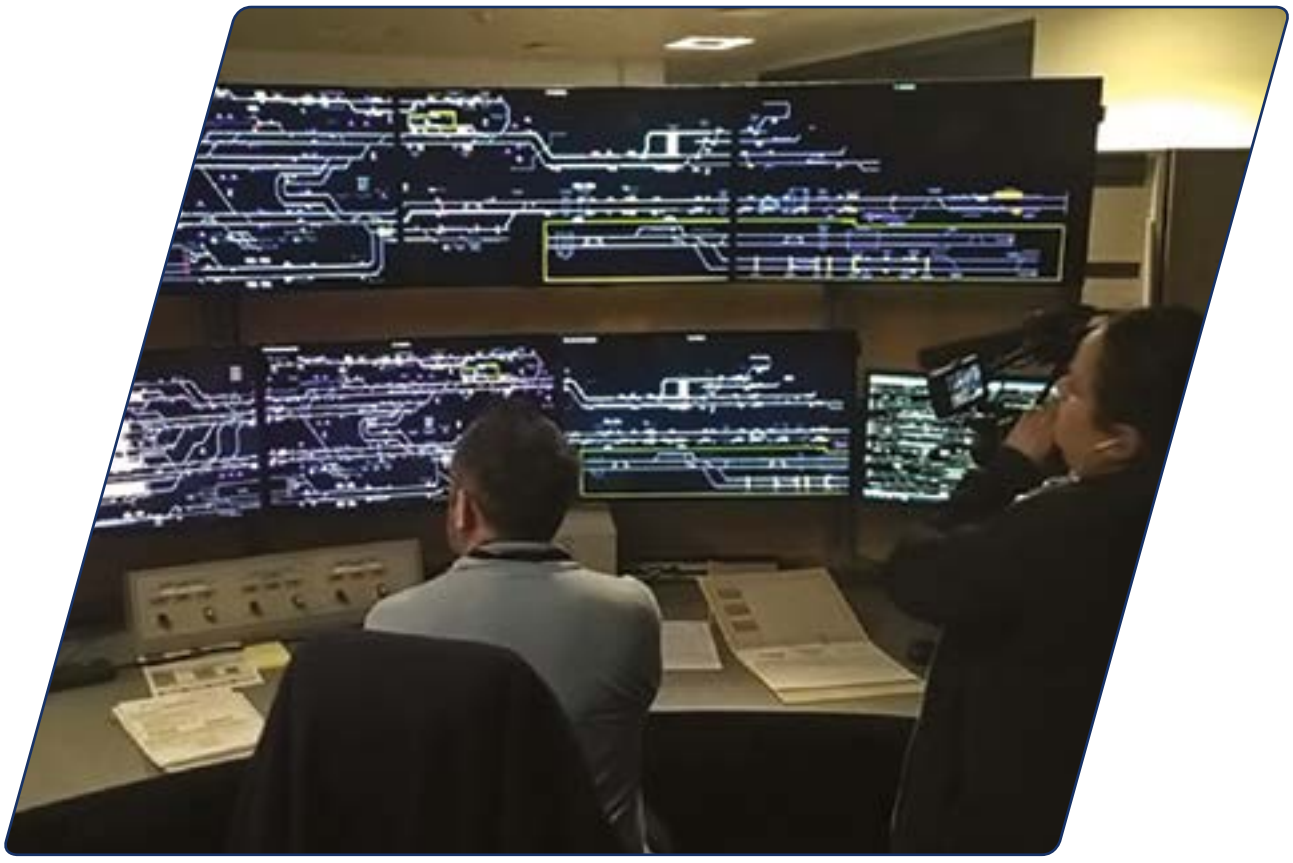
The data does give us some additional precision on some relatively familiar themes.

- The demand for skills in rail and road is increasing over time and without action there will be shortages and gaps. Now is a good time to invest in your own, or your workforce's skills. We expect provision of training and evidence of a skilled workforce to be an increasingly decisive factor in business success in transport infrastructure. Apprenticeships are one of the best ways, but not the only way, to achieve this.
- The workforce has large numbers of workers in the rail and road sectors who are due to reach retirement age in the next ten years – but we now know better which sub-segments will be affected first.
- We do need more, higher level and commercial skills – the opportunity afforded by higher level apprenticeships and potentially a better understanding of the market by students, must be grasped.
- In general, workforce demand will follow investment, so we will see increasing demand in the Midlands and North West, for example with the construction of HS2. Increasingly we are seeing the potential for investment projects to drive demand elsewhere, as with the example of Crossrail.
- In terms of digitalisation, much upskilling of the existing workforce will be required to optimise and maintain new digitally driven assets.

More specialist digital skills will also be required. Data analysis is one such example, and transport will be in competition with other sectors for these already scarce skill resources. New supply chains are likely to emerge to deliver some of these specialisms. This will be disruptive to existing suppliers, so we will need to develop existing staff as well as develop new talent. It will be important for this nettle to be grasped quickly.

- Lastly, productivity is not where it needs to be, however, our work has also shown that productivity is a jigsaw not a puzzle. Investing in skills is the first stage in a broad based approach; 15% improvement should be possible within 5 years through training alone. A more holistic approach should see 30% improvements in transport infrastructure unit costs. We can learn from other sectors in this respect, such as utilities and power. We are supportive of work to implement Transport Infrastructure Performance through the IPA and the Transport Efficiency Strategy through the Department for Transport and the rail and roads infrastructure clients.

It would be easy to read this as an even more clinical and decisive diagnosis of the skills problem. STAT is already driving improvements, removing barriers, exploiting latent demand, and encouraging collaboration to increase the quantity and quality of skills in the workforce. Partners are already taking action, contracts are being revised, apprenticeship starts are increasing, and diversity is improving. This report, and more importantly the underlying data, is guidance for our collective journey.



Appendices

Appendix 1: Table of Figures

Appendix 2: Workforce Data

From information provided by employers and data provided from Sentinel (the Rail industry personal safety standards database), we have accumulated the largest recent survey of the rail industry's workforce. The data has been converted into a common format, with common defined fields. These fields include:

- Employer
- Age
- Gender
- Location, which is then translated into a Region
  - East Anglia
  - East Midlands
  - London
  - North East
  - North West
  - Scotland
  - South East
  - South West
  - Wales
  - West Midlands
  - Yorkshire and the Humber
- Job role – as provided by employers. The Sentinel database does not hold job role data for individuals.
- Asset type
  - Civils and Structures
  - Electrification
  - Operations
  - Property, Stations & Depots
  - Signalling & Telecomms
  - Systems Engineering
  - Track
  - Traction & Rolling Stock
- Work type
  - Business Management
  - Investment Projects
  - Maintenance
  - Manufacturing
  - Operations
- Skill level
  - A – Operative (Levels 1 and 2)
  - B – Advanced / Higher Technician / Supervisor (Levels 3 and 4)
  - C – Professional / Manager / Engineer (Levels 5 and 6)
  - D – Executive (Levels 7 +)

Appendix 3: Assumptions

Rail

The process of the calculations

The Future Workforce is calculated in two ways:

- A continuation of existing roles (for Operations and Maintenance particularly) with an assumption of marginal efficiency gains;
- Analysis of Investment Plans, and developing a future workforce profile using workforce algorithms and assumed team sizes.

Continuation of existing roles

- For Network Rail, predictions of Operations staff are provided in Route Plans and Maintenance figures have been assumed to remain level per annum.
- For Transport for London (TfL), Operations figures have been assumed to remain level per annum.
- For TfL, Maintenance figures have been assumed to remain level per annum.
- For TOCs, the future workforce is assumed to continue at the rate each TOC has developed over the last 5 years; lowest is -0.1% per annum, highest is 4.4% per annum.
- For Traction & Rolling Stock, Maintenance numbers are based on fleet sizes increasing over time, and using a ratio of workers to fleet numbers.

Analysis of Investment Plans

- A number of sources have been identified, namely:
  - Network Rail CP5 plans & Hendy Report from 2016;
  - TfL Investment and Business Plans from December 2016;
  - Traction & Rolling Stock orders from Long Term Passenger Rolling Stock Strategy 2016;
  - HS2 Cost loaded programme from September 2015;
  - The National Infrastructure Delivery Plan 2016;
  - Other sources from previous Skills Forecast studies.
- The data has been taken, or calculated, to at least 2033;
- Investment data split into year, asset type and region (wherever possible) to enable closer interrogation;
- Two algorithms have been used:
  - A) Percentage of investment expenditure, by asset type, that is labour only; E.g.; 30% of Traction & Rolling Stock expenditure is UK labour;
  - B) Application of ratio of 'team constituency and size' per £1m of expenditure; E.g. 'v' number of Operatives, 'x' number of Supervisors, etc.

- Salaries and other employment costs have been factored in;
- Network Rail expenditure is only given to CP5: Beyond that, expenditure is modelled at a 0.5% annual reduction per asset type;
- TfL Projects expenditure is only provided in detail for known schemes to 2021, unless where an exception has been made (e.g. Crossrail 2);
- Traction & Rolling Stock investment has been modelled using the forecasts in the Long Term Passenger Rolling Stock Strategy;
- HS2 has been modelled using the Cost Plan made available to NSAR in September 2015 for Workforce and Apprenticeship modelling; and
- Other Passenger Transport Executive (PTE) schemes are modelled where known.

Road

The process of the calculations

The Future Workforce is calculated in two ways:

- A continuation of existing roles (for Maintenance particularly)
- Analysis of Investment Plans, and developing a future workforce profile using workforce algorithms and assumed team sizes.

Continuation of existing roles

- For all road workers, particularly in Maintenance, it has been assumed that these will continue at a similar rate.

Analysis of Investment Plans

A number of sources have been identified, namely:

  - Highways England Road Improvement Strategy (RIS 1)
  - Local Authority/Council Financial Plans
  - Department for Transport Roads Funding Information (January 2017)

The data has been taken, or calculated, to at least 2033 to be in line with Rail;

- Investment data split into year, work type, asset type and region (wherever possible) to enable closer interrogation;
- Two algorithms have been used:
  - A) Percentage of investment expenditure, by asset type, that is labour only;
  - B) Application of ratio of 'team constituency and size' per £1m of expenditure; E.g. 'v' number of Operatives, 'x' number of Supervisors, etc.
- Salaries and other employment costs have been factored in.

Appendix 4: Quality Assurance of NSAR Skills Intelligence Model

Investment Plans

We have collated information gathered from a variety of sources to produce a comprehensive overview of planned expenditure in both rail and road over the next 10 – 15 years.

Data has been sourced from:

- Network Rail CP5[11]
- TfL Investment and Business Plan
- Long Term Passenger Rolling Stock Strategy for the Rail Industry
- HS2 Cost Loaded Programme
- Road Investment Strategy Period 1 Procurement Plan
- Highways Maintenance Funding Formula Allocations
- Local Council and Local Authority Medium Term Financial Plans
- The National Infrastructure Delivery Plan
- Other sources from previous Skills Forecast studies

Information from Local Councils and Local Authorities provide planned expenditure up to and including 2021. Funding has been assumed to continue at the same rate as 2021, for the duration of the time frame in the model, where no further information has been published. Investment and maintenance expenditure are listed separately to allow clearer analysis of the type of planned spend. The Department for Transport funding formula allocations to local authorities have been used in conjunction with Medium Term Financial Plans to ascertain the proposed investment and maintenance costs.

Highways England investment plan information has been identified from the Road Investment Strategy and this has been cross checked with updates available through the Highways England website.

In rail, maintenance and operations figures have been assumed to continue at the same rate as has been previously identified.

Investment Plans for Network Rail are outlined in CP5, with further details of investment for TfL being accessed from Business plans and an industry wide Rolling Stock Strategy.

Future Workforce

Model Parameters: The outputs are generated using a formula which takes a Labour Percentage multiplied by the level of finance in the Investment Plan multiplied by a Workforce Pyramid, where the required number for each work type, asset type and skill level are utilised. This covers each organisation and each region.

11 The investment analysis in this study pre-dates the recently released Network Rail Strategic Business Plans for CP6.

e.g. Network Rail, Civils & Structures: Civils Other, Skill Level B, East Anglia in 2019:

Labour Percentage (%)		Investment Plan (£m)		Workforce Pyramid (No.)		Number of People Required
50	X	7.2	X	5.66	=	20.4

Model Assumption: Future workforce levels have been assumed to remain level beyond where information is in the public domain, i.e. 2021 for Rail and 2024 for Highways England Road responsibility. Local Councils and Local Authorities provide information up to and including 2021. Workforce pyramids have been generated from a previous version of a forecasting study. The labour percentage calculation is also based upon a previous version.

Input Validation: Data entry has been carefully monitored to eradicate errors. Cross checking has taken place across documentation and the variety of sources, checking for updated material and ensuring the parameters remain valid.

Accuracy: Error checking has taken place to remove any anomalies of formula from incorrect data entry. The Investment plan information is accurate from the source material. Any updates from refreshed material have been applied.

Reliability: From the baseline of Today's workforce, generated from information gleaned from the companies who deliver to and are part of the supply chain to the rail industry, including Train Operation Companies, the output numbers are reflective of workforce numbers. The quality of information gathered for the Investment Plans document derive from the published documents within the public domain.

Communication of Model Limitations: The model has been trialled initially with rail information to provide a benchmark. Further development of the model will allow continued review against this benchmark and the application of the formulae. Sensitivity and scenario testing have been carried out on separate occasions to test the validity and limitations of the model. The results have demonstrated the model can cope with adapted information and provide outputs according to the variables.

Risk: The security of the data stored within the model is paramount. All users have passwords. The risk surrounding the structure of the model has been evaluated and demonstrates the model is robust, managing multiple variables with efficiency and providing outputs which are reflective of manual calculations using a spreadsheet. Other risks include the data entry where there is the potential risk of error. This has been addressed through cross checking data entry and spot checks of testing values and formulae against a manual calculation.

Model Build: The model is being developed and has been built to apply the parameters to accurately project the number of workers required in each aspect of the rail industry, based upon work type, asset type, skill level and region.

Model Test / Results: The model is still in development, but testing which has taken place has shown the model is fit for purpose – projecting the number of workers required in various sectors of the rail industry, by work type, asset type, skill level and region. The model outputs are replicated by manual spreadsheet calculations.

Transparency: The model is subject to error checking, including the detail on the model assumptions as previously outlined. The output information is open to scrutiny as the ability to question the outputs is essential in ensuring the quality of the model. The information provided from the model outputs has been analysed at regional level, using a cross section of the variables.

Governance: The purpose of the model has been agreed between the developer and the Senior Model Owner. The risk assessment of the model has been taken into consideration and from the results, raised questions, challenged assumptions and established limitations. As a work in progress, it has been possible to adapt the model at each trial.